**State of Wisconsin**

## CORRESPONDENCE/MEMORANDUM

**DATE**: October 23, 1995

**TO**: Jamie Dunn, District Hydrogeologist
Northwest District Office
Department of Natural Resources

**FROM**: Kenneth Bro, Environmental Engineer
Bureau of Public Health
Department of Health and Social Services

**SUBJECT**: Health consultation on exposure to coal tar associated with the manufactured gas plant site in the City of Ashland.

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Here is the health consultation you requested regarding potential public contact with coal tar seeping from the site of a former coal gasification plant in the City of Ashland. You expressed particular concern about public contact with tar slicks on Chequamegon Bay resulting from disturbance of the coal tar in surficial sediments. The City of Ashland also requested information about the health effects associated with odors released during extraction of groundwater and disturbance of contaminated soil from the site.

**Background and Statement of Issues**

The site is at the top of a bluff near the shoreline of Chequamegon Bay on Lake Superior (see Figure 1). The coal gasification facility operated at the 300 block of St. Claire Street (one block north of U.S. Highway 2) from the 1880's until 1947. The facility manufactured coal gas until the 1920's, and then switched to water gas. During the time that the coal gasification plant operated, a former ravine extending from the site to Chequamegon Bay was filled with coal tar and fill soil. At its mouth the former ravine was 30 feet deep and 160 feet wide. A silty clay soil forms the natural base of the ravine. Under the silty clay unit is a confined, sandy aquifer that supplies two, nearby artesian wells on the lakefront. Lying over that base is as much as eight feet of soil saturated with coal tar. Above the tar-saturated soil is as much as twelve feet of soil that exhibits a strong coal tar odor. The remainder of the fill appears relatively clean. Coal tar in the former ravine lies below the water table.[1] The water table lies seven feet below the ground surface at the plant site, intersects the ground surface at the base of the bluff and extends about five feet below the surface of fill material on the lakeshore to the lake surface of Chequamegon Bay.

The area between the base of the former ravine and Chequamegon Bay is a ten-acre city park. A railroad track runs along the lakefront about halfway between the top of the bluff and the level park.

The distance from the base of the bluff to the edge of the bay ranges from about 300 to 500 feet. The park consists of fill placed on the former lake bed. Lying above the historic lake bed is up to six feet of wood waste (slab wood, bark, and sawdust) from lumber mills that operated on the lakeshore at the turn of the century. Above the wood waste is about five feet of fill soil. Volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) characteristic of coal tar fan out through the wood waste and former lake bed sands from the mouth of the former ravine toward the bay. The silty clay formation under the lake sand restricts downward flow of the coal tar waste.[2] Coal tar emerges in the sediments of the bay offshore.[3]

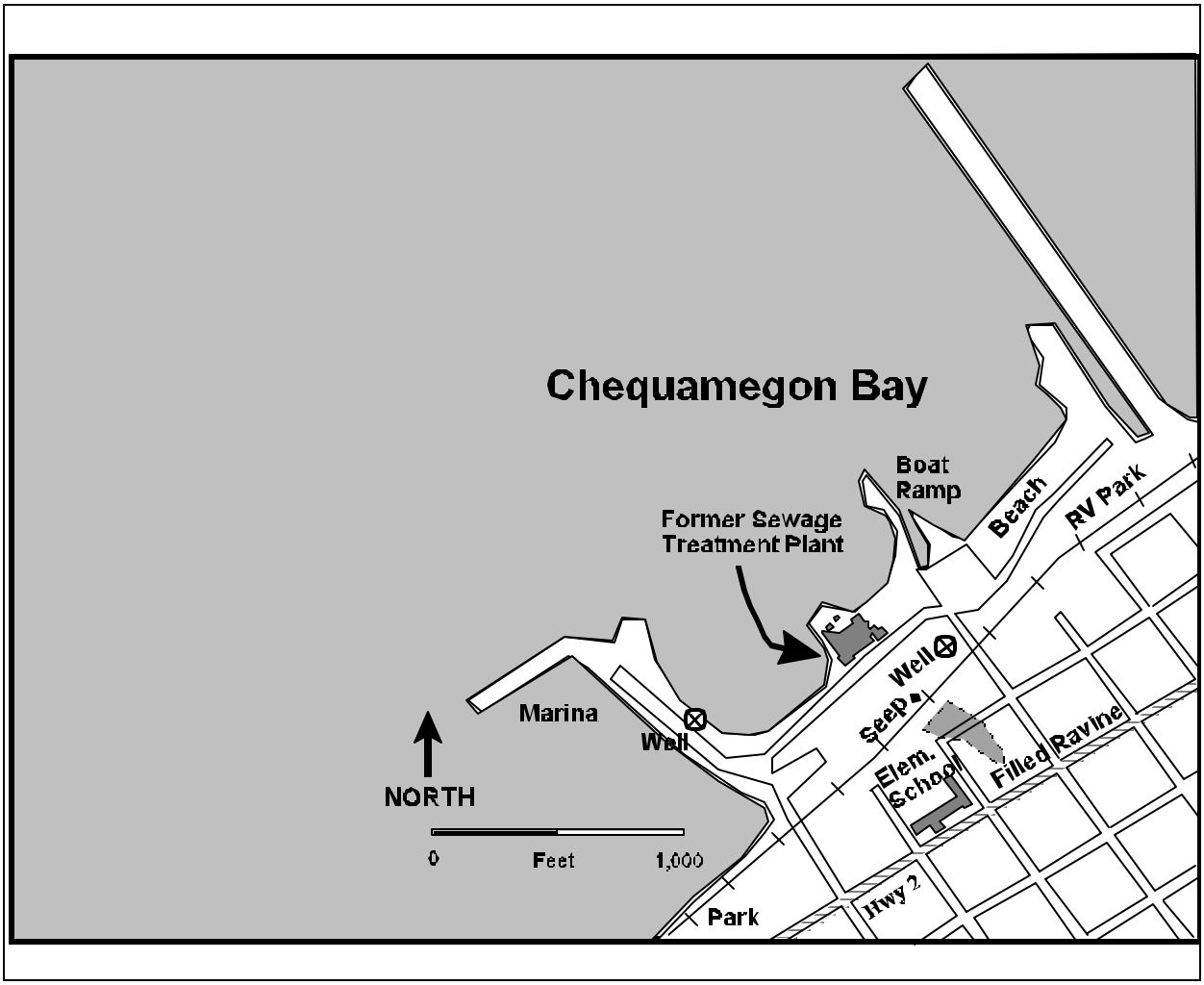


**Figure 1**. Location of the filled ravine at the manufactured gas site in the City of Ashland, Wisconsin.

At the base of the bluff near the mouth of the former ravine, is a groundwater seep with oily globs of coal tar floating on the surface. The seep is roughly ten square feet surrounded by weedy vegetation between the park and the railroad tracks. At the request of the Wisconsin Department of Natural

Resources (DNR), Northern States Power Company recently constructed a fence around the weedy area where the seep is.[4]

Currently at the site of the former coal gas plant are maintenance buildings and a paved parking lot of the Northern States Power Company (NSP). NSP now uses the filled area of the former ravine as a fenced, unpaved, storage area. The lakeshore park is readily accessible and is surrounded by facilities that draw people to the lakefront. Just west (across Third Avenue East) of the NSP property is the St. Agnes Elementary School. Just north of the plant site (across St. Claire Street) are six residences. Just east of the lakeshore park are a city marina, two hotels, and a lakefront park along U.S. Highway 2. Just west of the park area is Kreher Park, a city park with a swimming beach, a boat ramp, and a campground. At the western edge of the lakeshore park is an artesian well where people come to fill jugs with drinking water. The well extends into a confined aquifer lying below the silty clay formation and shows no signs of coal tar contamination. Along the lakefront north of the park area is the city's former wastewater treatment plant, now used as storage and office space by the Wisconsin Conservation Corps.[5]

On 14 August 1995 the DNR collected three sediment samples from Chequamegon Bay in the area between the former wastewater treatment plant and the city marina. The depth of water ranged from eight to ten feet, and the sampling locations were from 200 to 350 feet north of the lakeshore park. Simple disturbance of the lake bottom for collecting core samples caused coal tar to float to the water surface and form a slick.[6] All three sediment samples were tested for 17 PAHs and one was also tested for 72 VOCs (see table). The samples contained VOCs and PAHs characteristic of coal tar[7] and similar in composition to soil samples from borings in the former ravine and beneath the lakeshore park.[8] The sediment samples were not tested for phenols and cresols, and neither were soil samples from site investigations in fall 1994 and May 1995. Four phenolic compounds (total concentration less than 1 mg/L) were found in two of eight groundwater samples collected in May 1995. Groundwater water samples were collected from twenty locations in fall 1994 and May 1995. Groundwater samples were not tested for cresols.[9]

On 22 September 1995 a representative of the Wisconsin Division of Health visited the lakeshore park. Water in the area of the seep emitted a strong, foul odor. Woody sediment along lakeshore between the old treatment plant and the marina smelled of tar and was coated with dark, oily material.

**Discussion**

Disturbing surficial sediments contaminated with coal tar can cause slicks on the water surface. People may come into direct contact with the coal tar if they swim or wade in areas where there is a coal tar slick or if they touch surfaces covered by coal tar slicks. Given the accessibility of the lakefront and the frequent use of the nearby beach and boat ramp, it is reasonable to expect that people will get coal tar

on their skin and possibly in their eyes and mouth while swimming or wading in the bay at a time when a tar slick is present. They may also come in contact with tar in beach sand or on other materials along the shore. Ashland residents and Kreher Park campers use the beach in the summer, and boaters use the ramp from spring through fall. Anglers and waders searching for driftwoood wade in the area between the treatment plant and the marina. The frequency of episodes when coal tar slicks float to the shore is unknown and likely depends on both the frequency of incidents when contaminated sediments are disturbed and the direction of littoral currents when slicks appear.

**Organic compounds in sediment and groundwater.**

| Compound | Sediment Concentration[10] (mg/kg•dry weight) CHB1 | CHB2 | CHB3 | Detected Groundwater Concentration[11, 12] (µg/L) Low | High |
|---|---|---|---|---|---|
| **Carcinogenic PAHs** | | | | | |
| Benzo(a) pyrene | 130 | 41 | 130 | 3.39 | 7,754 |
| Benz(a) anthracene | 210 | 52 | 240 | 2.61 | 6,800 |
| Benzo(b)fluoranthene | 92 | 29 | 110 | 2.69 | 6,260 |
| Benzo(k)fluoranthene | 29 | 11 | 32 | 2.10 | 3,066 |
| Chrysene | 140 | 42 | 180 | 1.75 | 7,298 |
| Dibenz(a,h)anthracene | 9.2 | 3.7 | 14 | 1.45 | 624 |
| Indeno(1,2,3-cd)pyrene | 52 | 14 | 49 | 2.75 | 3,578 |
| **Non-carcinogenic PAHs** | | | | | |
| Acenapthylene | 140 | 5 | 33 | 3.53 | 3,823 |
| Acenapthene | 540 | 180 | 1,400 | 7.85 | 11,437 |
| Fluorene | 230 | 65 | 390 | 1.34 | 26,429 |
| Phenanthrene | 830 | 340 | 2,100 | 0.81 | 38,293 |
| Anthracene | 270 | 89 | 590 | 2.92 | 8,842 |
| Fluoranthene | 270 | 110 | 390 | 1.81 | 15,725 |
| Pyrene | 440 | 170 | 910 | 3.40 | 39,877 |
| Benzo(ghi)perylene | 52 | 14 | 47 | 3.26 | 4,022 |
| **Total PAHs** | **3,434.2** | **1,165.7** | **6,615** | | |
| **VOCs** | | | | | |
| Benzene | | 0.072 | | 1.29 | 20,500 |
| Ethylbenzene | | 12 | | 5 | 3,180 |
| Isopropylbenzene | | 3.1 | | -- | 16.3 |
| p-Isopropyltoluene | | 6.5 | | 9.18 | 75.1 |
| Napthalene | | 1,000 | | 0.41 | 18,600 |
| n-Propylbenzene | | 3.1 | | -- | 7.5 |
| Toluene | | 0.36 | | 0.36 | 10,000 |
| 1,2,4-Trimethylbenzene | | 29 | | 0.36 | 480 |
| 1,3,5-Trimethylbenzene | | 9.2 | | 5.0 | 200 |
| m/p-Xylene | | 8.9 | | 27·* | 5,180·* |

| | |
|---|---|
| o-Xylene | 4.9 |

* Total xylenes

While chronic dermal exposure to coal tar in the bay may be unlikely, even occasional episodes of acute exposure can pose a health hazard to those who swim or wade in the bay. Coal tar can cause mild to severe irritation of the skin and eyes. Acute exposure to the PAHs in coal tar can cause dermal inflamation and damage the skin's sebaceous glands. PAHs in coal tar can also induce phototoxicity of the skin. Phototoxicity is an exagerated response to sun exposure characterized by excessive sunburn.[13] Boaters or bathers who experience prolonged exposure to sunlight following contact with PAHs in coal tar would be particularly at risk of experiencing phototoxicity. Workers who handle coal tar have experienced eye irritation and conjuctiva burns.[14]

In addition to PAHs, phenols[15] and cresols[16] are components of coal tar that are strong irritants of skin. Because coal tar in bay sediments was not tested for phenols and cresols, concentrations of these substances are not known. Phenolic compounds in old coal tar wastes can degrade,[17] even in such anaerobic environments as saturated, subsurface soils.[18] Because some phenols were detected in two samples of groundwater (one from the lakeshore park and one from the filled ravine), it is difficult to evaluate whether these strongly irritating compounds are also present in the coal tar in bay sediments.

The VOCs and PAHs in coal tar are readily absorbed in skin, and benzene[19] and several of the PAHs[20] in coal tar are carcinogenic. However, it seems unlikely that people whose skin was coated with coal tar while using the lakeshore would allow such exposures to recur frequently enough to pose a significantly increased cancer risk. Because several of the constituents of coal tar are volatile, they escape readily into the air whenever contaminated groundwater, soil, or sediment are exposed to the atmosphere. Exposure to the odors of these volatile compounds can cause some people to experience headaches, dizziness, and nausea.[21] Because an elementary school and several residences are adjacent to the site, failure to control odors during remedial activities could affect sensitive individuals nearby. For example, pumping contaminated groundwater to the sewer system could release volatile, aromatic compounds to the air at the point of discharge or from emissions from sewer vents or nearby floor drains.

**Conclusions**

1. PAHs in coal tar pose a public health hazard to people whose skin or eyes are in contact with a tar slick. People at risk of such exposure include those who swim, wade, or play along the lakeshore near Kreher Park when tar slicks are present. Acute exposure to coal tar can irritate the skin and eyes and may induce phototoxicity, which can result in rapid sunburning.

2. Tar slicks can form on the surface of Chequamegon Bay when surficial sediments contaminated with coal tar are disturbed. Such disturbances can occur when boaters drop anchor in

contaminated sediments or when large waves stir up the lake bed.

3. The frequency of events when tar slicks form and float to areas where people swim and wade is unknown.

4. Remedial activities that bring contaminated media in contact with ambient are can release volatile compounds whose odors can induce headaches, dizziness, and nausea in sensitive people near the site.

**Recommendations**

1. Prevent people from coming in contact with tar slicks and reduce the extent of exposure among those who do. Such steps may include:
   - Post signs warning park users to watch for and to avoid tar slicks. Include instructions that those with tar on their skin should wash immediately with plenty of soapy water and should avoid exposing the affected skin to sunlight.
   - Establish procedures to clean up tar slicks promptly when they are spotted.

2. Prevent tar slicks from appearing. Such steps may include:
   - Create a "no-anchor" zone in the area over tar contaminated sediments. Set warning buoys outside the perimeter of area to warn boaters about the hazard.
   - Remove tar from direct contact with the waters of Chequamegon Bay.

3. Inspect Kreher Park beach, boat ramp pilings, and shoreline surfaces for any indications of past tar slicks. Use the information to identify which areas along the shoreline are most likely to be affected by possible future tar slicks.

4. Include provisions in planned remedial measures to control emissions of volatile aromatic compounds.

**References**

1. Dames and Moore. Draft site investigation report and remedial action plan: Northern States Power, Ashland, Wisconsin. June 27, 1995.

2. Short Elliott Hendrickson Inc. (SEH). Existing conditions report: Ashland lakefront property. SEH No. WIDNR9401. February 1995.

3. James R. Dunn, District hydrogeologist, Northwest District Office, Wisconsin Department of Natural Resources. Personal conversation. 22 August 1995.

4. James R. Dunn, District hydrogeologist, Northwest District Office, Wisconsin Department of Natural Resources. Personal conversation. 22 August 1995.

5. Kenneth Bro, Wisconsin Division of Health. Site visit of manufactured gas plant site, City of Ashland. Madison, WI. 13 May 1995.

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7. U. S. Deparment of Agriculture. The biologic and economic assessment of pentachlorophenol, inorganic arsenicals, creosote, Volume 1: wood preservatives. Technical bulletin No. 1658-1. November 1980. p.29.

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14. Agency for Toxic Substances and Disease Registry. Draft toxicological profile for creosote (coal tar and wood), coal tar and coal tar pitch. Atlanta, GA: ATSDR, August 1994.

15. Agency for Toxic Substances and Disease Registry. Toxicological profile for phenol. Atlanta, GA: ATSDR, December 1989.

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20. Agency for Toxic Substances and Disease Registry. Draft toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: ATSDR, October 1993.

21. New Jersey Department of Health. Hazardous substance fact sheet: coal tar pitch. Trenton, NJ, June 1994.